

CLAIMS

We claim:

1. A method of making conducting vias and conducting lines on a substrate comprising:

- 5 depositing a stack on a substrate, said stack comprising a first organic intermetal dielectric layer;
- forming a via opening in said stack;
- depositing a sacrificial inorganic dielectric in said via opening, said sacrificial inorganic dielectric substantially filling said via opening;
- 10 forming a line opening in said stack and said sacrificial inorganic dielectric, said line opening substantially aligned with said via opening;
- selectively removing said sacrificial inorganic dielectric; and
- filling said via opening and said line opening with conducting material.

- 15 2. The method of Claim 1 wherein said sacrificial inorganic dielectric is selected from the group consisting of methylsiloxanes, phenylsiloxanes, methylphenylsiloxanes, methylsilsesquioxanes, methylphenylsilsesquioxanes, silicates, perhydrosilazanes, hydridosiloxanes and organohydridosiloxanes described by the general formula $(H_{0.4-1.0}SiO_{1.5-1.8})_n (R_{0.4-1.0}SiO_{1.5-1.8})_m$ wherein the
- 20 sum of n and m is from about 8 to about 5000, and mixtures thereof.

3. The method of Claim 1 wherein said sacrificial inorganic dielectric is a methylsiloxane.

4. The method of Claim 1 wherein said organic intermetal dielectric layer comprises an organic dielectric selected from the group consisting of polyimides, polytetrafluoroethylene, parylenes, fluorinated and non fluorinated poly(arylene ethers), polymeric material obtained from phenyl-ethynylated aromatic monomers and oligomers, fluorinated amorphous carbon, and mixtures thereof.

Sub (B)

5. The method of Claim 1 wherein said stack further comprises a diffusion barrier layer between said substrate and said organic intermetal dielectric layer, and a hardmask layer on said organic intermetal dielectric layer.

5 6. The method of Claim 5 wherein said diffusion barrier layer comprises silicon nitride.

Sub #3

7. The method of Claim 5 wherein said hardmask layer comprises a material selected from the group consisting of silicon oxynitride, silicon oxide, and mixtures thereof.

Sub #3

10 8. The method of Claim 1 wherein said stack further comprises:
a diffusion barrier layer between said substrate and said organic intermetal dielectric layer;
an etchstop layer on said intermetal organic dielectric layer;
a second organic intermetal dielectric layer on said etchstop layer;
and
15 a hardmask layer on said second intermetal dielectric layer.

9. The method of Claim 8 wherein said diffusion barrier layer comprises silicon nitride.

20 10. The method of Claim 8 wherein said etchstop layer comprises a material selected from the group consisting of silicon oxide, silicon nitride, and mixtures thereof.

Sub #4

25 11. The method of Claim 8 wherein said second organic intermetal dielectric layer comprises an organic dielectric selected from the group consisting of polyimides, polytetrafluoroethylene, parylenes, fluorinated and non fluorinated poly(arylene ethers), polymeric material obtained from phenyl-ethynylated aromatic monomers and oligomers, fluorinated amorphous carbon, and mixtures thereof.

Sub 44
Cont'd

12. The method of Claim 8 wherein said hardmask layer comprises a material selected from the group consisting of silicon oxynitride, silicon oxide, and mixtures thereof.

Sub B1

13. The method of Claim 1 wherein said stack further comprises a diffusion barrier layer on said substrate, an inorganic intermetal dielectric layer between said diffusion barrier and said organic intermetal dielectric layer, and a hardmask layer on said organic intermetal dielectric layer.

14. The method of Claim 13 wherein said diffusion barrier layer comprises silicon nitride.

10 Sub 45

15. The method of Claim 13 wherein said inorganic intermetal dielectric layer comprises a material selected from the group consisting of silicon oxide, fluorinated silicate glass, organohydridosiloxanes described by the general formula $(H_{0.4-1.0}SiO_{1.5-1.8})_n(R_{0.4-1.0}SiO_{1.5-1.8})_m$ wherein the sum of n and m is from about 8 to about 5000, and mixtures thereof.

15 Sub B1

16. The method of Claim 13 wherein said hardmask layer comprises a material selected from the group consisting of silicon oxynitride, silicon oxide, and mixtures thereof.

17. The method of Claim 1 wherein said sacrificial inorganic dielectric is selectively removed with a buffered oxide etch.

Sub 46

18. The method of Claim 1 wherein said conducting material comprises a metal selected from the group consisting of aluminum, copper, tungsten, and mixtures thereof.

Sub B1

19. The method of Claim 18 wherein said conducting material further comprises a conducting diffusion barrier material.

Sub 47

20. The method of Claim 1 wherein said substrate is selected from the group consisting of semiconductor wafers, dielectric layers, and metal interconnect layers in integrated circuits.

21. The method of Claim 1 wherein said via openings and said line openings are formed by etching with an oxygen based plasma and with a fluorocarbon based plasma.

22. A method of making conducting vias and conducting lines on a substrate comprising:

- depositing a stack on a substrate, said stack comprising a first organic intermetal dielectric layer;
- forming a line opening in said stack;
- depositing a sacrificial inorganic dielectric in said line opening, said sacrificial inorganic dielectric substantially filling said line opening;
- forming a via opening in said stack and said sacrificial inorganic dielectric;
- selectively removing said sacrificial inorganic dielectric; and
- filling said via opening and said line opening with conducting material.

23. The method of Claim 22 wherein said sacrificial inorganic dielectric is selected from the group consisting of methylsiloxanes, phenylsiloxanes, methylphenylsiloxanes, methylsilsesquioxanes, methylphenylsilsesquioxanes, silicates, perhydrosilazanes, hydridosiloxanes and organohydridosiloxanes described by the general formula $(H_{0.4-1.0}SiO_{1.5-1.8})_n (R_{0.4-1.0}SiO_{1.5-1.8})_m$ wherein the sum of n and m is from about 8 to about 5000, and mixtures thereof.

24. The method of Claim 22 wherein said sacrificial inorganic dielectric is a methylsiloxane.

25. The method of Claim 22 wherein said organic intermetal dielectric layer comprises an organic dielectric selected from the group consisting of polyimides, polytetrafluoroethylene, parylenes, fluorinated and non fluorinated poly(arylene ethers), polymeric material obtained from phenyl-ethynylated aromatic monomers and oligomers, fluorinated amorphous carbon, and mixtures thereof.

Sub B1
26. The method of Claim 22 wherein said stack further comprises a diffusion barrier layer between said substrate and said organic intermetal dielectric layer, and a hardmask layer on said organic intermetal dielectric layer.

5 27. The method of Claim 26 wherein said diffusion barrier layer comprises silicon nitride.

Sub H10
28. The method of Claim 26 wherein said hardmask layer comprises a material selected from the group consisting of silicon oxynitride, silicon oxide, and mixtures thereof.

Sub B1 10
29. The method of Claim 22 wherein said stack further comprises:
a diffusion barrier layer between said substrate and said organic intermetal dielectric layer;
an etchstop layer on said intermetal organic dielectric layer;
a second organic intermetal dielectric layer on said etchstop layer;
and a hardmask layer on said second intermetal dielectric layer.

15 30. The method of Claim 29 wherein said diffusion barrier layer comprises silicon nitride.

31. The method of Claim 29 wherein said etchstop layer comprises a material selected from the group consisting of silicon oxide, silicon nitride, and mixtures thereof.

Sub H11 20
25 32. The method of Claim 29 wherein said second organic intermetal dielectric layer comprises an organic dielectric selected from the group consisting of polyimides, polytetrafluoroethylene, parylenes, fluorinated and non fluorinated poly(arylene ethers), polymeric material obtained from phenyl-ethynylated aromatic monomers and oligomers, fluorinated amorphous carbon, and mixtures thereof.

Sub
A/11
cont'd

33. The method of Claim 29 wherein said hardmask layer comprises a material selected from the group consisting of silicon oxynitride, silicon oxide, and mixtures thereof.

Sub
B'

5 34. The method of Claim 22 wherein said sacrificial inorganic dielectric is selectively removed with a buffered oxide etch.

Sub
A/12

35. The method of Claim 22 wherein said conducting material comprises a metal selected from the group consisting of aluminum, copper, tungsten, and mixtures thereof.

Sub
D'

10 36. The method of Claim 35 wherein said conducting material further comprises a conducting diffusion barrier material.

Sub
A/13

37. The method of Claim 22 wherein said substrate is selected from the group consisting of semiconductor wafers, dielectric layers, and metal interconnect layers in integrated circuits.

Sub
B'

15 38. The method of Claim 22 wherein said via openings and said line openings are formed by etching with an oxygen based plasma and with a fluorocarbon based plasma.